2.1 Principles of Ecology, Organisms + Their Relationships

Review vocab: Species: a group of organisms that can interbreed and produce fertile offspring

Chapter Main idea: Biotic + Abiotic factors interact in complex ways in communities and ecosystems

I. Ecology

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A. Ecology – the scientific discipline in which the relationships among living organisms and the interaction the organisms have with their environment are studied

1. In a nutshell, ecology is the study of organisms and how they interact with their environment + other organisms

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2. Models allow ecologists to control the number of variables present and to slowly introduce new variables in order to fully understand the effect of each variable

II Biosphere – the portion of Earth that supports life

A. "Bio" = life, sphere = round like a ball
→ "ball of life", but there is more to it

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B. Biosphere includes landmasses, bodies of freshwater and salt H_2O, and all locations below Earth's surface that supports life

→ Figure 3

C. Biotic Factors

1. The living factors in an organism's environment are biotic factors

→ Figure 4

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D. Abiotic Factors

1. The non-living factors in an organism's environment

a. abiotic factors vary greatly for organisms

b. examples: temperature, air or H_2O currents, soil type, etc.

2. Organisms are adapted to surviving in the abiotic factors that are present in their natural environments

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III Levels of organization (Figure 5)

A. Levels of Organization include

★ Organism → Population → Biological Community → Ecosystem → Biome → Biosphere

1. Population - individual organisms of a single species that share the same geographic location at the same time

2. Biological Community - a group of interacting populations that occupy the same area

B. Ecosystems, biomes, and the Biosphere

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1. Ecosystem- a biological community and all of the abiotic factors that affect it
2. Biomes- a large group of ecosystems that share the same climate and have similar types of communities

C. Ecosystem Interactions
1. The interactions between organisms are important in an ecosystem
2. Habitat- an area where an organism lives
3. Niche- the role or position that an organism has in its environment

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a. An organism's niche is how it meets its needs for food, shelter, and reproduction
b. A niche might be described in terms of requirements for living space, temperature, moisture, or in terms of appropriate conditions for reproduction

D. Community Interactions
1. Organisms that live together in a biological community constantly interact
a. these interactions along with abiotic factors shape an ecosystem

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2. Competition- occurs when more than one organism uses a resource at the same time
   a. resources might include: food, water, habitat, etc.
   b. "Survival of the fittest"

E. Predation- many species get their food by eating other organisms

1. Symbiotic Relationship- some species survive because of relationships they have developed with other species

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a. when two or more species live and interact together, we call this symbiosis

Species 1	Species 2
+	+
+	+/-
+	-

2. Mutualism: when two species live and interact together in a way that is beneficial for both species
   → Figure 8
3. Commensalism - a relationship in which one organism benefits and the other organism is neither helped nor harmed
4. Parasitism: a relationship in which one organism benefits at the expense of another organism (Figure 9)

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2.2 Flow of Energy in an Ecosystem

→ Main idea: Autotrophs capture energy making it available for all members of a food web

→ Review vocab: energy - the ability to cause change; energy cannot be created or destroyed, only transformed

I. Energy in an ecosystem

A. Autotrophs - an organism that collects energy from sunlight or inorganic substances to produce food

1. Autotrophs are primary producers (e.g. plants)

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B. Heterotroph - an organism that gets its energy requirements by consuming other organisms

1. Heterotrophs are also called consumers
   a. A heterotroph that eats only plants is an herbivore (cow)
   b. A heterotroph that preys on other heterotrophs are carnivores (wolf)
   c. animals that eat both plants and animals are omnivores (humans)
   d. detritivores eats fragments of dead matter in an ecosystem

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→ detritivores return nutrients to the ecosystem so that they can be reused by organisms (i.e. worms)

→ decomposer, similar to detritivores break down organisms by releasing digestive enzymes (fungi, bacterial)

e. all heterotrophs perform some decomposition when consuming other organisms

f. detritivores + decomposers are essential to break down organic material

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II Models of Energy Flow

A. Each step in a food chain or food web is called a trophic level

1. Autotrophs are the first trophic level in all ecosystems

a. heterotrophs make up the remaining levels

b. with the exception of the first trophic level, each trophic level gets energy from the trophic level before it

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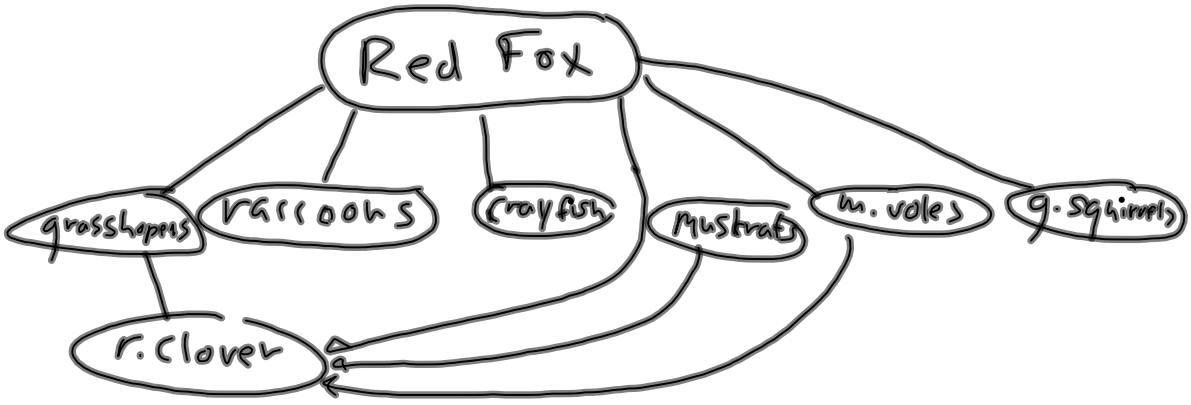

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B. Food Chain - a simple model that shows how energy flows through an ecosystem

→ Figure 17

1. Arrows represent the one-way energy flow that is usually from autotrophs to heterotroph

C. Food Web - a model representing the many interconnected food chains and pathways in which energy flows through a group of organisms

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D. Ecological Pyramid - a model that shows how energy flows through ecosystems

→ Figure 14

1. Most energy contained in organisms at each level is consumed by cellular processes or released to the environment as heat
2. Biomass: the total mass of living matter at each trophic level - decreases at each trophic level

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2.3 Cycling of Matter

Main idea: Essential nutrients are cycled through biogeochemical processes

Review vocab: cycle - a series of events that occur in a regular repeating pattern

I. Cycles of Biosphere

A. Energy is tranformed into usable forms to support the functions of an ecosystem

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1. A constant supply of energy is needed but matter must be cycled through the biosphere

B. Law of conservation of mass: matter is neither created nor destroyed
1. Therefore matter must cycle through the biosphere through natural processes
2. Matter - anything that has mass and takes up space
a. Matter provides nutrients needed in order to function

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3. Nutrient - a chemical substance that an organism must obtain from its environment to sustain life and to undergo life processes
a. bodies of organisms are built from H_2O and $C_1 N_1 P$

C. The cycling of nutrients in the biosphere involves both matter in living organisms and physical processes found in the environment such as weathering

D. The exchange of matter through the biosphere is called a biogeochemical cycle
→ Figure 15

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II The Water Cycle

A. Organisms need H_2O to survive

1. Hydrologists study water (groundwater)

⭐ → Figure 16

B. Evaporation - when energy (sunlight usually) hits liquid H_2O, it causes it to form vapor and the vapor rises into the atmosphere

C. Transpiration (a form of evaporation) - the release of H_2O from plants

D. Condensation - when H_2O vapor loses energy it condenses into droplets around dust particles in the atmosphere (clouds)

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E. Precipitation - the release of H_2O from clouds in the form of rain, sleet, snow or hail, transferring H_2O to the Earth's surface

1. Groundwater and runoff from land surfaces flow into streams, rivers, lakes, and oceans to evaporate and continue the H_2O cycle

III Carbon and Oxygen Cycle

A. All living things are composed of molecules that contain carbon

1. Atoms of C form the framework for important molecules such as proteins, carbs., and fats

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2. Carbon + Oxygen make up molecules essential for life * (Figure 17) *

B. Oxygen Cycle
1. Photosynthesis (plants converting solar energy into food) in green plants converts $CO_2 + H_2O$ into carbs and release O_2 back into the air

C. Carbon Cycle
1. Centers a long-term cycle when organic matter is buried underground and converted to peat, coal, oil, or gas deposits
a. Fossil Fuels are burned/used which releases CO_2 back into the atmosphere

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2. Carbon + O_2 can combine w/ calcium to create ($CaCO^3$) calcium carbonate. Rocks are exposed to weathering and the rocks release C + O back into the atmosphere

IV The Nitrogen Cycle
A. Nitrogen is an element found in proteins
1. Largest concentration of Nitrogen is found in the atmosphere
B. Plants and animals cannot use the N found in the atmosphere
1. N gas is captured from air by bacteria in H_2O, soil, or in the roots of some plants
C. The process of Nitrogen being captured + converted into a usable form is called Nitrogen Fixing

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D. N enters the food web when plants absorb N compounds from soil and convert them into proteins
→ Figure 19
1. Consumers get N by eating plants or animals that contain N
2. The amount of N that is fixed limits the growth of producers

E. N returns to the soil through several ways:
→ Figure 19
1. Animal urine, organisms dying return N to soil

F. Through denitrification, some soil bacteria convert fixed N compounds back into N gas which returns to the atmosphere

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V. The Phosphorus Cycle (P cycle)

A. Phosphorus is an element that is essential for the growth and development of organisms
→ Figure 20

B. Short-term cycle of phosphorus
1. P in phosphates is cycled from soil to producers, then producers to consumers
2. When organisms die or produce waste products, decomposers return the P to soil to be reused by other organisms

C. Long-term cycle of P
1. P moves from short-term to long-term through precipitation + sedimentation to form rocks
2. Weathering of rocks slowly add P to soil to rejoin short-term P cycle
3. P is a factor that limits the growth of producers

HW → 2.3 # 1-5

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